Chapter Eight
The Alternatives

Conserving Energy

The cheapest, most sensible way to avoid air pollution and global warming emissions from fossil fuels is to simply avoid the need for their use. Conservation and improved efficiency provide an enormous well of energy that now flows unused through our windows, tailpipes, and walls.

Since the first oil shock of 1973, the United States has begun to tap the conservation well. As a consequence, the United States today uses 28 percent less energy to produce a dollar of gross national product than it did in 1973,[180] and the potential for further savings are vast. Other countries, such as Germany and Japan, are twice as energy efficient as the United States.

The notion that energy consumption must necessarily expand as economic growth occurs was tossed out years ago by informed economists, but industry interests and traditional energy planners are understandably loathe to relinquish their hold on the marketing of energy. In the late 1970s when President Jimmy Carter extolled the American people to save energy, many scoffed, but energy conservation has worked beyond expectations.

Since the late 1980s, the United States is saving 14 million barrels of oil every day,[181] because of "plugged steam leaks, caulk guns, duct tape, insulation," and increased auto fuel efficiency.[182] Those energy savings have also resulted in an annual benefit of $150 billion in reduced fuel costs in the United States.[183]

With this historical perspective, the impetus to expand efficiency and conservation should be powerful, but the Reagan and Bush administrations were steadfastly resistant to energy reform. According to the Worldwatch Institute, all U.S. spending on energy efficiency research and development combined in 1990 would have financed the U.S. military forces in the Persian Gulf for less than three days.[184] Yet in the midst of the Persian Gulf War, the Bush administration released its National Energy Strategy with a commitment to the status quo: fossil fuel and nuclear energy as the cornerstones of America's energy future.

The potential energy savings to be achieved by energy efficiency alone should be of vital interest to the country that contributes nearly one-quarter of the world's fossil fuel-generated carbon dioxide emissions. Writing in *Issues in Science and Technol-*

ogy, Michael Shepard, Director of the energy program at the Rocky Mountain Institute states:

> Estimates of untapped energy savings range widely, but they are all large. The Electric Power Research Institute, the utility industry's research arm, estimates that U.S. electricity demand could be reduced by up to 44 percent by the year 2000 through efficiency gains made with existing technology. My colleagues and I at Rocky Mountain Institute believe that the potential cost-effective savings are even larger, conceivably as much as 75 percent of total U.S. energy demand.[185]

These figures sound almost unbelievable. Indeed, in the current political reality and an energy market absorbed with fossil fuels in general and natural gas in particular, they are not realizable. A full-out reorientation of the country's energy policy must begin soon if these energy savings are to be effected in time to slow climate change and allow implementation of clean energy systems. Although the Clinton/Gore administration promises to return to the principles espoused by Carter in the 1970s—efficiency and renewables—their early policy statements regarding expanded use of natural gas and "clean" coal are in conflict with that promise.

Energy Efficiency in Less-Industrialized Countries

Energy efficiency is also critically important to the less-industrialized world, where energy consumption is predicted to increase precipitously during the next 20 years. If traditional approaches to energy use continue, CO_2 emissions from Eastern Europe and less-industrialized countries could exceed those from all industrialized countries combined by the year 2010.[186]

This will result in a double tragedy. The first is that global warming emissions and the full range of fossil fuel cycle impacts will wildly increase. The second is that the harsh poverty under which much of the world's population now lives will also increase. Centralized fossil fuel systems and large-scale hydropower displace people in order to provide energy to industrial centers and the elite few, but often do not provide relief to poor people who cannot find enough energy for cooking and other survival activities due to increasing shortages of biomass for fuel. People who do not have enough wood to cook rice live within a stone's throw of 36-inch pipelines conveying natural gas to urban centers.

The World Bank estimates that investments of $1 trillion will be required in the next decade to meet just the electricity needs of less-industrialized countries, yet only $10 to $12 billion per year will be available from the multilateral lending agencies (which provide 80 percent of the foreign exchange for power sector investments).[187]

Many less-industrialized countries are already under crippling debts incurred for energy—up to 40 percent of the accumulated public debt in some countries.[188] Yet free trade accords such as NAFTA and the Enterprise for the Americas Initiative will lock in dependence on fossil fuels as an export commodity, as well as exclude demand-side energy planning that would save finite resources and dollars. (See Stump and Alexander. *The North American Free Trade Agreement and Energy Trade*. Washington, DC: Greenpeace, 1992.)

Furthermore, the U.S. Office of Technology Assessment reports that increasing combustion of fossil fuels has resulted in air pollution levels in the cities of less-industrialized countries that are among the highest in the world.[189]

Many countries now face energy choices that will endure for decades. Industrialized countries must contend with the inertia of existing infrastructures that stifle energy reform, but younger countries can more quickly implement efficiency measures and renewable systems that are not only cost-effective and sustainable, but that can mitigate poverty and create durable employment. Encouragement from international lending institutions would provide a substantive incentive to choose clean energy alternatives, but there is little indication that the World Bank and others will significantly shift from the current priorities of lending for fossil fuel expansion or destructive large-scale hydro—at least not without international pressure to do so.

Jose Goldemberg, et al. writing for the World Resources Institute, report that energy conservation with use of the best energy efficient technologies alone may be adequate for meeting the present needs of less-industrialized countries without increasing the energy supply.[190] The International Institute for Energy conservation has suggested that with only a 10-percent increase in energy use, the most energy efficient technologies could raise the average standard of living to the level of Western Europe in the 1970s.[191] That 10 percent, and much more, could be provided by renewable energy systems.

These figures, too, sound almost unbelievable in the context of the current political structure and a global energy infrastructure and marketplace that is so heavily weighted toward fossil fuels. But the technological realities of clean energy are very much with us. The barriers are political.

For those who find such projections difficult to believe, there is the real world perspective of what has already been accomplished with efficiency improvements: in the United States, measures to conserve energy have provided seven times more energy since 1973 than all other efforts combined to build new power plants and drill new gas and oil wells.[192]

Advocates for what has become, for all intents and purposes, a fossil fuel ideology, will deny and resist this reality for as long as the market for fossil fuels holds up. Because the objective of this ideology is to ever build the supply of energy, there is fundamental resistance to attempts to decrease the demand for the energy. This seems a simplistic statement, but it is profoundly at the heart of the seeming ease with which methane—another finite, polluting fossil fuel—has been so readily endorsed when alternatives are at hand.

The Cost of Clean Energy Versus Fossil Fuels

Proponents of natural gas and other traditional fuels argue that renewable energy systems are not practical for widespread applications, not cost-effective, and not available today. On the contrary, appropriately scaled, regionally tailored renewable energy systems are cost-competitive with fossil fuels and nuclear energy today even though they have been forced to develop without the help of government subsidies that favor conventional fuels.

For those of us in the United States, it is "cheap" to step on the gas or turn up a thermostat because we have been awash in fuels that move cheaply onto the marketplace. However, the costs of the fuels manifest themselves in tangible ways that we have been conditioned to ignore.

For example, the United States spends about $100 billion each year on gasoline and another $100 billion each year in attempts to mitigate the impacts of air pollution—costs that do not show up at the gas pump.[193] As another example, researchers at Cornell University estimate that energy-related ozone emissions reduce U.S. crop yields by as much as 30 percent.[194] Some estimates place the "hidden" costs of energy use in the United States as high as $300 billion a year.[195] That amount is in addition to an annual fuel bill approximating $450 billion.

However, many fossil fuel or nuclear energy externalities are not quantifiable using present-day models. How does one quantify the true cost of an *Exxon Valdez* or a Chernobyl? Or of destruction of natural habitat, loss of species diversity, boom-bust employment cycles, build-up of toxic wastes, human poverty, global warming, and forest death?

These are the questions that must be asked before energy choices are made, and they are the kinds of questions that are too seldom addressed in the United States, where the fossil fuel industry not only inflicts a huge cost on people and the environment, but receives upward of $26 billion every year in federal tax credits and subsidies.[196] If these subsidies were stripped away and the hidden costs accounted for, we would likely find that it is fossil fuels, not renewable sources, that have never become truly cost-effective sources of energy.

It is remarkable to realize that even in the face of market barriers, political opposition, and a powerful ideology, renewable energy systems have still accomplished quantum technological leaps in the last decade.

Wind power is competitive with some utility systems even without subsidies and externality costing requirements. U.S. Windpower, Inc. has produced a technology that generates electricity for 5 cents/kilowatt-hour.[197] A U.S. DOE-sponsored study reports that the wind power available in just 12 states in the country's midsection is more than enough to provide for all U.S. electric power needs.[198]

Solar energy technologies have made similar advances. The U.S. DOE has projected that system and operating costs for solar thermal electric-generating and process heat plants will be competitive with fossil-fired power plants by 1995.[199] Photovoltaic (PV) costs have dropped precipitously, despite seemingly insurmountable political and market-place resistance. Present costs are still greater than conventional electricity, but are rapidly falling. With PV, the pay-back time and convenience weigh in heavily. A 40-square meter solar array mounted on a south-facing rooftop in an area of average solar radiation in the United States produces as much electricity as is consumed by a typical U.S. household.[200]

Land-use constraints of solar power and wind are frequently cited as obstacles to widespread use, but in fact, the land-use requirements of renewables are less than or equivalent to those of fossil fuel, nuclear, and large-scale hydro. The difference is that conventional fuels use (and usually destroy) land at the point of extraction, whereas renewables use (and usually sustain) land at the point of generation.

Missing the Boat

It may be that the United States has already irretrievably relinquished its once-leading edge on renewable energy technologies. Renewable systems that were invented and proven in the United States have been taken over by Japan, Germany, and other countries, because the United States has created political and economic disincentives against them. The United States will be faced with the irony of importing these technologies back into the country once the rest of the world has effected the transition to clean energy.

Renewable technologies offer the opportunity to diversify economies, create employment, and generate energy that does not poison the planet. Recent studies of energy industry employment indicate that, overall, renewable energy sources employ two to five times as many people for every unit of electricity generated as fossil or nuclear sources.[201] Energy conservation measures create even more jobs than renewables. For every $1 billion that is shifted from fossil fuel installations to investments in efficient and renewable energy installations, 30,000 job-years will be created.[202] This comes as no surprise when one considers that non-fossil energy systems are much more labor-intensive and that they process a sustainable resource; there is no bust to follow jobs created by clean energy.

Another positive benefit of clean energy technologies is that they can spawn new industries. For example:

> "the Japanese successfully supported their photovoltaics industries while they developed a market in consumer products. Now, millions of calculators all over the world are powered by Japanese solar cells. We would do well to learn from their example."[203]

The United States will not regain its lead in innovative clean energy technologies if the status quo continues. Two disparate studies by the U.S. DOE give an indication of what is needed. One study estimated that the contribution of renewables to the U.S. energy mix would rise by only 15 quads (annual energy use from all sources is around 85 quads); the second study projected that renewables could provide 90 percent of the 111 quads needed by the year 2010. The factor creating the wide discrepancy is different assumptions about the level of federal research and development funding: from 1981 to 1989, this funding dropped by 84 percent.[204]

The National Energy Policy Act of 1992 has, finally, mandated a few subsidies for renewable energy and efficiency, but they are far too meager and long overdue. Much more substantive efforts to correct fossil fuel-biased markets will be required to slow the rate at which natural gas is monopolizing supply decisions for the utility and transportation sectors.

Threshold Opportunities: A Case In Point

Commonly heard arguments against wind and solar energy cite problems with energy storage and transmission and lack of applicability as a transportation fuel. Solar-generated hydrogen fuel has the promise to stand up to all these concerns. Of particular promise are hydrogen fuel cells.

Hydrogen fuel, if generated by clean energy sources, is pollution-free (with the exception of minute quantities of nitrogen oxide) and produces no global warming emissions.[205] Most hydrogen production today results from the use of fossil fuels as raw material. Solar hydrogen would use only water, energy from the sun, and the components of a photovoltaic system (which are not without toxicity problems).

A 1991 Sandia National Laboratory study contracted by the U.S. DOE concluded:

> We can continue to expand valuable hydrocarbons as our main source of hydrogen, or we can start now and by the late 1990s have profitable commercial solar hydrogen production plants coming on line. We must start now.[206]

Unfortunately, the U.S. DOE has not heeded this excellent advice. As has been the pattern in the 1980s with renewable technologies, other countries have been quick to recognize the promise of solar hydrogen. U.S. funding for solar hydrogen research and development has run around $3 million a year, compared to $20 million in Japan and $50 million in Germany.[207]

As we now import crude oil from Saudi Arabia, will we some day import solar hydrogen in cryogenic tankers? Germany and Saudi Arabia are working together on an extensive solar hydrogen demonstration project with a PV generator coupled with an electrolysis plant in Saudi Arabia. A study from the Abdulaziz University in Saudi Arabia concluded that the country's large desalinization system, its location in the sun-belt, and its expertise in energy production all promise that "Saudi Arabia can acquire a prominent place in the world as a net exporter of solar hydrogen energy...in the early part of the 21st century."[208]

One of the most comprehensive analyses of solar hydrogen to date was completed by Joan Ogden and Robert Williams for the World Resources Institute. They found that if only 10 percent of fleet vehicles in the United States were converted to hydrogen, demand would be great enough to justify pipeline construction from the U.S. Southwest (where insolation—sunlight to surface area—is high) to the Northeast in order to move solar hydrogen to that region.[209]

Arguments against using solar hydrogen as a transportation fuel are similar to those that constrained compressed natural gas-powered vehicles in the past. For example:

1) both have a public perception of fire/explosion risk;

2) both have a low density of energy (in comparison with gasoline), requiring greater quantities of fuel on board and limiting driving range;[210]

3) both are lacking in coordinated distribution systems (although CNG stations are quickly springing up);

4) both require relatively expensive modifications of vehicles to permit their use.

There are three significant factors that they do not have in common:

1) one is finite, polluting, and a cause of global warming;

2) one has an infrastructure in place for production, distribution, and marketing;

3) one has powerful political backing.

Ogden and Williams suggest that the technological constraints (development of more efficient PV modules and highly fuel efficient vehicles) to widespread solar hydrogen use in transportation can be overcome by the turn of the century, but only if public policy initiatives "facilitate a shift from fossil fuels to PV hydrogen."[211]

In 1992, legislation was introduced to provide support for solar hydrogen as a transportation fuel, but received so little interest that the bill has been rewritten to favor hydrogen production from natural gas. (Hydrogen produced from methane would increase CO_2 emissions by 25 percent over gasoline, and cost 4.4 times more.[212]) The advocates for solar hydrogen have not found a champion in Congress; most congressional committees are sold on natural gas and clean coal.

Findings such as those from the Sandia National Laboratory study are falling on deaf ears, and the country is rapidly losing the opportunity to take the lead in solar hydrogen research and development. Sandia's suggestion that industry and government should share the cost of pilot-scale development with the use of existing government-owned solar collector systems has not been implemented, although the payback potential would be significant and include:

1) reduced consumption (conservation of natural hydrocarbons);

2) reduction of CO_2 and other pollutants;

3) generation of domestic and world markets for solar hydrogen processes.[213]

Most studies suggest that although hydrogen is the clear choice for the long term, we must accept the convenience and political acceptability of natural gas for the short term (i.e., two decades) as a transition fuel.[214] Some suggest that hythane (a mix of hydrogen and methane) be used with incrementally increased portions of hydrogen to phase out methane over the next few decades. But, again, once the infrastructure and market incentives are firmly in place for natural gas, there will be little will to convert to hydrogen and other available renewable technologies until we have exhausted "cheap" natural gas. And, if the price of gas becomes prohibitive and/or supply limited, the distribution infrastructure for natural gas can also transport synthetic fuels made from coal and other dirty carbon fuels already owned by the same companies—just as many of the power-generating systems coming on line today will be able to burn the gasified fuels.

Energy Choices Made Now Will Last Decades

The industrialized North and large multilateral lending institutions inflict their bias for fossil fuels on long-term energy planning in the less-industrialized world. This has been the case for decades, but in the era of global free markets, free trade agreements driven by the North, not national governments, will largely determine policies of energy extraction and consumption.

As one example of the threshold moments for energy choices in the coming years, the government of Pakistan has moved to expand oil and gas production, remove controls on upstream oil and gas operations, and "cut red tape in permitting,"[215] in order to attract foreign investors—a process that is underway in virtually all countries now.

At the same time, the Clean Energy Research Institute in Florida published a report entitled *A Clean and Permanent Energy Infrastructure for Pakistan: Solar-Hydrogen Energy System*, which found that implementing a solar hydrogen infrastructure in Pakistan would "eliminate the import dependence of fossil fuels, increase gross product per capita, reduce pollution, improve quality of life, and establish a permanent and clean energy system."[216]

We have singled out solar hydrogen as an example of missed—or about to be missed—opportunities. But we would caution that no one energy system can provide a long-term solution for global, sustainable energy. It would be a grave error to advocate one particular fuel as the panacea to the world's energy dilemma. This is the sort of simplistic thinking that entrenched us in oil addiction, and threatens to do the same with natural gas.

One of the benefits of renewable energy systems is that they are diverse, and so can be appropriately selected and scaled for the communities they serve. No energy system is without its downside in terms of environmental and human health, but thoughtfully selected renewable energy mixes that are used with maximum efficiency can minimize negative impacts in ways that will never be possible for fossil fuels, nuclear power, or large-scale hydropower.

Conclusion

Efficiency and renewable energy systems can slow climate change processes and reduce pollution of air, land, and water. They can also help stabilize the world economy. Natural gas cannot.

Viewed in isolation, certain attributes of natural gas make it seem less harmful than other carbon-based energy sources: lower carbon content, fewer emissions of sulfur and reactive hydrocarbons, and reduction of nitrogen oxide emissions when used in stationary sources. Viewed synergistically, however, the impacts of natural gas production, distribution, and combustion on the global and local environments make it clear that this fuel is not the benign little blue flame it is portrayed to be.

As the accolades for natural gas continue to pile up, as the infrastructure to produce and distribute gas grows ever more extensive and the marketplace more biased, the future becomes more certain for long-term expanded use of this fuel. Natural gas is excluding the entry of renewable energy and efficiency into the utility and transportation sectors.

The United States has only the space of a few years to reverse this trend. Once the next round of competitive bidding for new electricity supply is completed and combustion turbines and combined cycle systems are in place; once Detroit has retooled for natural gas vehicles and CNG refilling stations are in every city, we will be stuck paying off the tremendous sunk costs of that investment. We will not have another opportunity to implement clean energy again for decades.

Perpetuating fossil fuel dependence in the United States is not the only concern. In today's reign of free markets and free trade agreements, industrialized countries cannot make energy choices in isolation. Accords such as the North American Free Trade Agreement and the Enterprise for the Americas Initiative will ensure that the entire Western Hemisphere must follow the lead of the world's most energy-hungry country down the fossil fuel dead-end street.

Indeed, all less-industrialized countries are under tremendous pressure from the North to open their borders to Northern-based transnational oil and gas corporations. Borderless, unregulated trade in fossil fuels will certainly enhance corporate profits for the next several decades, but it will do nothing to achieve genuine energy security for all peoples. Efficient energy systems that provide services to people can mitigate poverty and environmental degradation, and earn profits that are free of boom-bust cycles and depleted resource bases.

The consequences of global warming—sea level rise, drought, catastrophic typhoons and hurricanes, forest death, epidemics—will likely be the most severe in the countries lining the equatorial belt: countries that are today making the choice to build a fossil fuel infrastructure rather than a renewable one. This impending tragedy is all the more disturbing for the fact that equatorial belt regions are ideally situated for optimum renewable energy potential from the sun and wind. This is not to say that effects of climate change will not be catastrophic in the United States as well, where the grain belt may shift to more northern latitudes, and what remains of the Gulf of Mexico wetlands and the cities of the east coast may be lost to sea level rise.

It is ironic that the Bush administration and other national governments have not questioned the need for supply mega-projects such as the Trans Alaska Gas System, the massive natural gas pipeline on the drawing board for Southeast Asia, or the gas pipeline that will connect the Russian Arctic with Japan evan as the U.S. DOE National Energy Strategy minimized the potential of solar energy systems. It is also ironic that the magnitude of subsidized coalbed methane production, for example, was unflinchingly accepted, while wind power technologies that have accomplished clean, competitive, cost-effective power generation without subsidies are still resisted by traditional energy planners. Ironic that we can dream up outlandish carbon-sequestering projects to trap CO_2 emissins from fossil fuels, evan as we continue to dream up outlandish carbon-sequestering projects to trap CO_2 emissions from fossil fuel combustion and inject them into the depths of the oceans

The Clinton/Gore administration has come to office at the precise moment when the country sways at a crossroad of possible energy futures. The impetus to continue on the path of fossil fuels is powerful, but both leaders have demonstrated their commitment to change, and to ensuring that the needs of all people are met—including the most basic need for a healthy world. Reversing their endorsement of natural gas is critical if they hope to remain consistent with that commitment.

Notes and References

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3. As a rough rule of thumb, a one-degree Celsius change in temperature is equivalent to a change in latitude from 100 to 150 kilometers. Houghton, Richard, and George Woodwell. "Global Climatic Change." *Scientific American* 1989, p. 43.

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7. The United States is uniquely poised to launch demonstration projects of workable, available clean energy technologies and to assist other countries to implement them.

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17. Hirshberg and Scullery, op. cit, note 12.

18. Anonymous. "National Energy Strategy Passes Congress: Boost Seen for AFV's." *AFDC Update* Washington, DC: Alternative Fuels Data Center, November 1992.

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21. Personal communication from Kevin Jardine, Greenpeace Canada Atmosphere and Energy Campaign. Jardine cites from "The Significance of Methane Emissions from Natural Gas Operations in Canada Relative to the Natural Environment and Global Warming" by the Canadian Gas Association, 1989, which estimates average carbon dioxide emissions from natural gas wells at 7 percent with a high of 24 percent. It is not known at this writing if this estimate includes CO_2 vented during the refining process, but presumably not.

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